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HUMAN ANATOMY.

(1) *A Treatise on Applied Anatomy.* By Edward H. Taylor, M.D., F.R.C.S.I. Pp. xxvii+738; 178 figures and plates. (London: Charles Griffin and Co., Ltd., 1904.) Price 30*s.* net.

(2) *The Human Sternum.* By Andrew Melville Paterson, M.D. Pp. 89; 10 plates. (London: Published for the University Press of Liverpool by Williams and Norgate, 1904.) Price 10*s.* net.

(3) *Der Gang des Menschen.* v. Teil. Die Kinematik des Beinschwingens. By Otto Fischer. Price 5 marks. vi. Teil. Ueber den Einfluss der Schwere und der Muskeln auf die Schwingbewegung des Beins. By Otto Fischer. Price 4 marks. (Leipzig: B. G. Teubner, 1904.)

(1) TO those unfamiliar with the ways of modern medicine the continual appearance of new works on human anatomy must cause some surprise. No subject should be better known, for it has been a matter of almost universal study for centuries. At the best, many will conclude, a new text-book on applied anatomy—the kind of anatomy the surgeon and physician more especially need—can only be a re-setting of old facts, and an examination of Dr. Taylor's work will show that, to a large extent, the conclusion is justified. The steady advance of surgery necessitates a continual rearrangement of anatomical perspective; the areas of the body which were under a surgical taboo to the septic surgeons of former days are open to the clean operator of modern times. The brain and spinal cord, the cavities of the ear and nose, the organs within the thorax and abdomen, and the great joint cavities of the limbs, have come, one after the other, within the field of everyday surgical procedure during the last thirty years. In his treatment of these parts of the body Dr. Taylor is quite up to date; his pages reflect accurately the best opinion that is to be found in modern text-books of anatomy and surgery. Still, modern advances will not altogether explain the rapid appearance of new works on anatomy or on any other subject; every generation demands its books on science or literature wet from the press.

The study of this work, containing more than half a million words, furnished with highly finished figures, written with clearness and accuracy, raises the question: is the modern surgeon, as seen in a text-book such as this, a more scientific man than his predecessor of fifty or a hundred years ago? A consideration of a number of subjects in this work, in the treatment of which Dr. Taylor is neither better nor worse than other rising surgeons, will show that, as thinking men, they compare unfavourably with surgeons of past periods. The subjects referred to deal with (1) the appendix vermiformis, the seat of appendicitis; (2) the prostate, which becomes so frequently enlarged in old men; (3) the epididymis, a structure connected with the testicle and very liable to disease; (4) the gall bladder, interesting in connection with the formation of gall-stones; (5) the antrum of the mastoid, an air space connected with the middle ear; (6) the air spaces opening into the cavity of the nose. These six structures are selected because, during the last twenty or thirty years, they have been the subjects of the keenest inquiry, and surgeons have published their observations concerning them in thousand upon thousand of treatises and articles. One would expect that the basis of their treatment would rest on an intimate knowledge of the normal use of these structures. John Hunter, Everard Home, and John Hilton would certainly have sought a complete knowledge of the functions of these parts to serve as a foundation for a rational treatment. Dr. Taylor adopts the orthodox view as regards these structures; he describes their shape, position, and relationships, and the routes by which they may be reached, but not a word is said of their use. Perhaps it is unfair to blame Dr. Taylor for this omission, because it must be confessed that we know much more of the diseases of these structures than of their normal function. Yet in a text-book written for house and operating surgeons surely it is the duty of the author to point out essential gaps in our knowledge rather than to gloss them over by a multitude of unessential details. This criticism is the more pertinent because the author in this case has not taken a narrow view of applied anatomy; he devotes a very large part of his space to a description of operative procedures, pathological processes, embryological defects, and introduces here and there points in physiology.

A great part of this work consists not of applied, but of purely descriptive anatomy. Some years ago Waldeyer, of Berlin, gave an elaborate description of some ten or twelve areas he distinguished within the human pelvis—all of which have been adopted in this book; yet not a word is said as to what manner of use a surgeon can possibly apply them. Again, as regards a small peritoneal recess, which may occur to the left of the terminal part of the duodenum, all the various forms which have been described by hair-splitting surgeons are reproduced in detail. An elaborate description of the condition known as knock-knee is supplied, yet no mention is made of how bones react in their growth to the forces which are brought to bear on them, nor is there any allusion to the forces which normally act on the knee joint.

Surgeon-anatomists have a fondness for the application of certain proper names to surgical procedures and anatomical structures—such as the "pouch of Prussak," the "fossa of Landzert," "Gosselin's fracture," &c. An examination of the index of this work shows that more than one hundred such terms are used, yet, in comparison with many works, the number is indeed very moderate; but one feels they are still rather many. Many terms introduced by surgeons are not words which may be used easily, such as "cholecystotomy" (opening the gall-bladder), "cholecystectomy" (excision of the gall-bladder), "cholecystenterostomy" (making a communication between gall-bladder and intestine), "choledochotomy" (opening the bile duct).

(2) In this monograph, a companion to one on the human sacrum, published in 1893, Prof. Paterson

gives the facts gathered and the conclusions reached during a prolonged research into the development, comparative anatomy, and nature of the human sternum. Leaving aside the convenience of having our scattered knowledge on this subject summarised, and the value of the mass of evidence collected during the examination of hundreds of individuals, the main importance of the work lies in two conclusions which Prof. Paterson draws concerning the nature of the sternum:—(1) that it is fundamentally part of the shoulder girdle; (2) that it is not a segmental structure. Both these inferences are at variance with accepted opinion.

At the present time it is universally taught that the sternum in mammals, birds and reptiles—that is to say, in all vertebrates which use the body wall for the purposes of inspiration—is a composite bone derived from a fusion of the ventral ends of the ribs. The sternum is thus regarded as a structure of costal origin, and having only a secondary connection with the shoulder girdle. In Amphibia, on the other hand, it is recognised that the sternum is developed in continuity with the shoulder girdle, of which it forms an intrinsic part; it is in them a shoulder-girdle sternum. That the shoulder-girdle sternum represents the more primitive type, and that from such a type the costal sternum of the Reptilia was evolved, are assumptions which comparative anatomists will freely grant. At present, however, there is a distinct break in our knowledge of the history of the sternum; no intermediate forms between those two types are believed to occur, and no one, with perhaps the exception of the late Prof. T. J. Parker, has ever formulated a definite theory as to the manner in which the costal sternum of Reptilia could have arisen from the amphibian shoulder-girdle sternum. Prof. Paterson's investigations help us very materially to trace the origin of the costal or, as it may more truly be named, the "respiratory" sternum of the three higher classes of vertebrates from the simple sternum of Amphibia. He shows that the "respiratory" sternum arises developmentally in continuity with the precoracoid element of the shoulder-girdle, and quite independently of the ribs, and that it is therefore merely a modified form of the amphibian shoulder-girdle sternum. Further, the various forms assumed by the "respiratory" sternum in reptiles, birds, and mammals do not, when rightly interpreted, favour Gegenbaur's conception of its evolution by a fusion of the ventral ends of ribs. The sternum of amphibians is the median ventral element of their shoulder girdle, and when Prof. Paterson states that no corresponding element is developed elsewhere in the median ventral line, he overlooks the cartilage developed as a median ventral element in the pelvic girdle which in every sense exactly corresponds to the sternum.

The origin of the "respiratory" sternum is part of a wide problem, viz. in what manner and under what conditions did the body wall become modified to serve as an active inspiratory agent in higher vertebrates, thus replacing the "pharyngeal pump" of amphibians? Whatever may have been the exact manner in which the one form of respiration was evolved from the other, there can be no doubt that the ribs, the intercostal muscles, and the sternum as we know them in higher vertebrates appeared during this phase of evolution. Their appearance is directly due to the introduction of a new type of respiration; the sternum which serves in the higher forms as an element of the respiratory thorax is totally unlike the bone which merely served as part of the shoulder girdle in the more primitive type. With this evidence clearly in view it is difficult to understand how Prof. Paterson concludes that even in mammals the sternum is still—what it was when it first appeared in vertebrates—functionally and fundamentally an adjunct or element of the shoulder girdle. We are surprisingly ignorant of the part played by the sternum in the movements of respiration, even in man, but a cursory examination of its respiratory movements in various groups of birds, and in several orders of mammals, quickly serves to show that its form and size depend chiefly not on the movements of the forelimbs, but on the part it plays in the respiratory movements of the thorax. In our opinion the key to the morphology of the sternum is an accurate investigation of its function.

Prof. Paterson is undoubtedly right in regarding the sternum as primarily a continuous unsegmented median bar. The conception of the sternum as a segmental structure he characterises as "a nebulous transcendental notion." Yet his own evidence shows that the greater part of the mammalian sternum, at the commencement of the cartilaginous and osseous stages of development, is laid down as a truly segmental structure, each segment corresponding exactly to a body segment. Much more "nebulous and transcendental" appears to us his explanation of the occurrence of bony segments or sternabræ as "due to the traction or pressure on the part of the ribs and costal cartilages." In support of this theory Prof. Paterson cites the fact that centres of ossification appear in bones at points of traction and pressure. In the case of the sternum, however, the centres of ossification appear not opposite such points, but exactly between them.

This monograph is well got up; the figures are numerous and highly finished. There is evidently a slight error in Fig. 35, plate v.; the centre of ossification for the fourth segment (if the term may still be used) of the mesosternum is stated to be present in 71 per cent. of cases, whereas in the text (p. 18) the proportion is given as 26 per cent. A curious misprint occurs on p. 33, where the centre just alluded to is said to appear in 59 per cent. of children before birth, and 15 per cent. *after death*—probably meaning after birth.

(3) The brothers Weber were of opinion that in the forward swing of the leg in walking the lower extremity acted as a pendulum, the chief force in action being that of gravity. Duchenne, on the other hand, as the result of a special investigation, came to a totally different conclusion, viz. that the forward swing was almost wholly due to the direct action of muscle. In the fifth and sixth parts of his research into the mechanics of the human gait, Prof. Fischer concludes, after an elaborate analysis of the force expended during

the movement, that Duchenne comes much nearer the truth than the brothers Weber, muscular action playing a much larger part than the force of gravity. Those who have watched the passive movements of a paralysed leg during attempts at progression will have no difficulty in accepting Prof. Fischer's results.

The problem of estimating theoretically the force necessary to produce the forward swing of the lower extremity in walking is an extremely complicated one. Prof. Fischer regards the lower extremity as a pendulum made up of three segments, each of which undergoes certain secondary movements during the swing of the entire extremity. Further, the hip joint, from which the pendulum is suspended, undergoes an irregular forward movement during the swing of the limb. The resistance and elasticity of the muscles and ligaments and the friction at the various joints are factors which can only be approximately estimated.

By means of photographic records Prof. Fischer was able to subdivide the forward swing into forty and forty-one equal phases of time, and by estimating the amount of force in action during each phase he shows that gravity alone can account for only a minor fraction of the force necessarily expended in the movement. Further, the positions assumed by the foot, leg, and thigh during a forward swing show distinctly that various groups of muscles are then in action. He recognises four periods in the forward movement of the limb, each of which is characterised by the action of a distinct group of muscles. In the commencing phase the ilio-psoas bends the thigh on the body, the rectus femoris extends the leg forwards, the tibialis anticus bends the foot upwards; in the second phase the gluteus maximus and hamstring muscles draw the thigh backwards; in the third phase the knee is flexed by the gastrocnemius and short head of the biceps; in the final phase the muscles in front of the leg are again in action, and remain powerfully contracted until the sole of the foot is again planted on the ground.

These results are certainly much more in keeping with clinical and everyday experience than those of the brothers Weber. Many who only occasionally take long walks must have observed that one of the first groups of muscles to give out are those in front of the leg, and that they feel painful only at the end of the forward swing, when the heel reaches the ground—the period at which Prof. Fischer shows these muscles come most powerfully into action. A. KEITH.

EARTHQUAKES.

Earthquakes. By Clarence Edward Dutton, Major, U.S.A. Pp. xxxiii+314; 63 illustrations. (London: John Murray.) Price 6*s.* net.

EPITOMISED and carefully digested accounts of seismological investigations made during the last twenty-five years are few in number. Two have been published in England, a compilation has been "made in Germany," and now we have a volume from the distinguished geologist, Major C. E. Dutton, of the United States. All told, therefore, we have only four books which give the uninitiated some idea of what the new seismology means and what it has accomplished. About the old seismology, volumes, papers, and particularly sermons exist in thousands. But if we except a few, and amongst the few the works of Mallet stand high above the rest, all they give are reiterated narratives of what people saw and heard, now and then enlivened by some wild hypothesis or pious reflection.

Major Dutton's work belongs to another category, and rather than telling us what earthquakes do, his main object has been to tell us what they are, and while doing this he has kept abreast with the work of others which his own inquiries in the domain of seismic and volcanic activities have enabled him to present in a terse and accurate form.

Everything is discussed with a minimum of mathematics from a strictly scientific standpoint, whilst that which is sensational has properly been most carefully put under taboo. A justification for the exclusion of what is of practical importance, which gives not only to the man in the street but to Governments some inkling as to the use of earthquakes, is not so apparent. It is extremely likely that a Prime Minister may not care a twopenny-bit whether the inside of the world on which he lives is red hot or stone cold, while he might be extremely interested to know that seismograms may afford a satisfactory explanation for the interruption of his cablegrams. The importance of earthquake writings to communities who have been alarmed by accounts of disasters in foreign countries is self-evident, while it would at least be consoling to those who were suddenly cut off from the outer world by the failure of their cables to learn whether such failures were the result of an operation of war or of nature. A knowledge of how to construct so that earthquake effects should be minimised means the saving of life and property in countries subject to seismic disturbances. Seismic charts indicate positions where it is dangerous to lay deep-sea cables, whilst they tell the hydrographer where he may expect to find changing depths. In these and in a variety of other directions seismology helps to make communities comfortable, and at the same time acts as incentive to create a popular interest in and to obtain support for a young science. But as Major Dutton defines his standpoint, and as a volume of 300 pages cannot contain everything, our remarks on omissions must only be taken as indications of the hydra-headed nature of seismology.

The first four chapters are chiefly devoted to the cause of an earthquake, which is defined as anything that "calls suddenly into action the elasticity of the earth." Explosions at volcanic foci produce a local trembling, but they are comparatively of rare occurrence and seldom disturb large areas. When a long fault line is produced, and a large territory carrying perhaps mountain ranges drops down along its length, instrumental observations have revealed the fact that the world may be shaken as a whole. Subsequent adjustments along such a line due to intermittent recovery from overstrain and settlements of disjointed materials give rise to numerous after-shocks which are only sensible over areas of small size, and it seems